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Host Tree Selection by Overwintering Yellow-bellied Sapsuckers (*Sphyrapicus varius*) in Western North Carolina

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Abstract

The Yellow-bellied Sapsucker (*Sphyrapicus varius*) is the only true migratory woodpecker in eastern North America. It overwinters in Mexico and the southern United States, including western North Carolina. During the winter, sapsuckers drill small circular wells into sapwood in pursuit of xylem sap. The goal of this study was to understand the host tree preference of overwintering Yellow-bellied sapsuckers in the Southern Appalachians. I located sapsucker host trees and compared them with the closest non-host tree with the same canopy class. Sapsuckers did not prefer any specific tree species. I found drillholes on 18 host tree species, compared with 21 non-host tree species, showing that sapsuckers are generalist feeders. Host trees selected by sapsuckers were significantly larger (DBH = 55.2 cm) than non-host trees (DBH = 44.8 cm). Despite their larger size, host trees were more likely to have a crown class of B or C (52.1%) while non-host trees were more likely to have a crown class of A or B (87.5%), indicating that host trees were more likely to have lost branches. More long-term monitoring of Yellow-bellied sapsuckers is necessary to understand their effects on tree health.

1. Introduction

The Yellow-bellied Sapsucker (*Sphyrapicus varius*) is the only true migratory woodpecker in eastern North America. It has a large breeding range, spanning from eastern Alaska to Newfoundland southward into the Appalachians and western North Carolina[1,2]. During the winter, the Yellow-bellied Sapsucker migrates into Mexico and the southern United States, including western North Carolina. On a national level, it is listed as Secure, meaning the species does not face any current threats. However, the species is declining in North Carolina, where it has the statewide status of Significantly Rare[3].

Yellow-bellied sapsuckers eat a variety of foods including fruits, insects, and xylem and phloem sap[1,2,4]. Xylem and phloem sap are its main foods and are used in different periods of the year. In the summer, sap is obtained from shallow lattice-patterned phloem wells[5]. In winter and early spring, xylem sap is obtained by drilling small circular holes into the sapwood[4,5]. Over time calluses (woody tissue) build up to form horizontal shelflike girdles on the trees surface at the site of drilling[7] and are indicative of repeated use. Thus, YBSA drilling remains evident for years, and can be surveyed year-round.

Yellow-bellied sapsuckers are known to use ~250 species of native trees and woody vines in the United States[6,7]. During the winter months, sapsuckers likely test the sapping potential of all tree species present[8]. Despite the wide distribution of host trees, sapsuckers have been shown to select trees with higher sugar concentrations in the sap[4,9]. My objective was to investigate Yellow-bellied Sapsucker winter host tree selection in western North Carolina. Knowing the preferred tree species of Yellow-bellied sapsuckers in the southern Appalachians can help further the protection of this significantly rare migratory woodpecker.

2. Methodology

I conducted my study at eight different sites within Pisgah National Forest in western North Carolina (Table 1). Because breeding YBSA are uncommon in the mountains, and dietary needs can differ between breeding season and winter, I focused on the host trees of overwintering birds. I limited my study to sites <3,500 ft in elevation as sapsuckers breed at elevations higher than this. I chose forested areas where birders on eBird.com have reported sightings of Yellow-bellied sapsuckers during winter months.

Table 1. Study sites with elevation and number of host trees.

Site	**Location**	**Number of Host Trees (and Non-host)**	**Elevation (feet)**
Big Ivy	Barnardsville	20	2600
Bent Creek Research Forest	Asheville	20	2000
DuPont Forest	Cedar Mountain	20	2200
Black Mountain Campground	Burnsville	25	2900
Davidson River Campground	Pisgah Forest	19	2200
John Rock Loop Trail	Pisgah Forest	18	2200
Pink Beds	Pisgah Forest	22	3100
Cradle of Forestry	Pisgah Forest	16	3000

I visited each site twice, between May and August 2021. At each site, I searched for trees used by sapsuckers along established trails through mature hardwood forests. Searches lasted for 3 hours or until I had encountered 10 host trees. On each visit a different area of the site was searched. Host trees were identified as those with small holes drilled into the sapwood in even horizontal patterns. Each time I found sapsucker drillings on a host tree, I identified the tree to species, categorized the number of drillings (>25 or <25), measured the diameter at breast height (DBH), and recorded elevation, callus presence, canopy class (canopy or sub-canopy), and crown class (A, B, C, D). The crown classes were A (> 75% crown cover), B (25-75% crown cover), C (< 25% crown cover), and D (0% crown cover; dead). Crown class was used as an estimate of tree health, as there is evidence that Yellow-bellied sapsuckers preferentially feed on trees with declining health (Eberhardt 2000). I considered trees with >25 drillings to have sustained or repeated use.

For each host tree, I selected the closest tree with the same canopy class that did not exhibit drillings. I collected similar variables for the non-host tree (species, DBH, elevation, and crown class). A paired t-test was used to compare the DBH of non-host trees and host trees, to determine whether Yellow-bellied sapsuckers selected host trees based on their size.

3. Results

Table 2: Percentage of each host and non-host tree species.

Species	**Host Tree (%)**	**Non-host Tree (%)**
Tsuga canadensis	21.3	10.0
Liriodendron tulipifera	20.0	16.3
Acer rubrum	16.9	15.6
Quercus alba	9.4	5.0
Pinus echinata	6.3	3.1
Magnolia fraseri	4.4	0.6

Betula lenta	2.5	7.5
Carya tomentosa	2.5	0.6
Carya glabra	2.5	1.3
Magnolia acuminata	2.5	1.3
Oxydendrum arboreum	2.5	8.1
Quercus montana	2.5	3.1
Acer saccharum	1.9	---
Quercus rubra	1.9	3.8
Prunus serotina	1.3	---
Carpinus caroliniana	0.6	---
Fagus grandifolia	0.6	5.6
Quercus falcata	0.6	0.6
Pinus strobus	---	6.9
Platanus occidentalis	---	3.8
Quercus velutina	---	0.6
Quercus coccinea	---	3.8
Robinia pseudoacacia	---	0.6
Betula alleghaniensis	---	1.9

Table 3: Mean characteristics of host trees and non-host trees.

	Host Tree	**Non-host Tree**
Mean DBH (cm)	55.2	44.8
Canopy Class		
Canopy (%)	91.9	90.6
Subcanopy (%)	8.1	9.4
Crown Class		
A (> 75%)	45.0	58.1
B (25 - 75%)	34.4	29.4
C (< 25%)	18.1	12.5
D (0%)	2.5	---
Callus Prescence (%)	23.1	---
>25 Drillings (%)	63.1	---
<25 Drillings(%)	36.9	---

I located 160 host trees and 160 non-host trees. Host trees included 18 species and non-host trees included 21 species (Table 2). The most frequented host and non-host trees were *Tsuga canadensis*, *Liriodendron tulipifera*, and *Acer rubrum*. Host trees selected by Yellow-bellied sapsuckers were larger (mean = 55.2 cm DBH) than non-host trees (mean = 44.8 cm DBH). Non-host trees are more likely to have a crown class of A (58.1%), while host trees were more likely to have a crown class of B, C, or D (55.0%). Nearly all host trees were canopy trees (vs. subcanopy), and two-thirds of host trees had > 25 drillings, indicating repeated use.

4. Discussion

Yellow-bellied sapsuckers did not show preference for any particular tree species. My results indicate that they were generalist feeders, selecting 18 different host tree species (Table 2) and corroborates, previous findings of generalist feeding by sapsuckers. Beal[6] and McAtee[7] reported that Yellow-bellied sapsuckers use ~250 different species of native trees and woody vines in the United States. However, my study is the first to my knowledge to explore sapsucker feeding in the Southern Appalachian Mountains. Graves[8] predicted that sapsuckers test the sap potential of all trees

present with in their habitat range during winter months[8]. This could explain why host trees had so many drill holes. Of the 18 host species, three made up more than half of the trees selected: *Tsuga canadensis* (Eastern hemlock, 21.25%), *Liriodendron tulipifera* (Tulip poplar, 20.0%), and *Acer rubrum* (Red maple, 16.88%). All three are abundant in Western North Carolina and grow to large heights and diameters. I suspect Eastern hemlocks would have made up a greater percentage of host trees had their population not been diminished due to the invasive Hemlock Wolly Adelgid. Yellow-bellied sapsuckers are known to preferentially select trees with higher sugar concentrations in their sap[4,9], but I did not investigate this in my study.

Host trees and non-host trees in this study were mostly canopy trees, but trees selected by Yellow-bellied sapsuckers had significantly larger diameters than non-host trees. Sapsuckers may be targeting larger trees, because of a known preference for trees with greater sap flow[4,9]. Additionally, they may be targeting larger trees to minimize the number of trees they visit. Despite their larger DBH, host trees may have been more likely to be in low health. Host trees were more likely to have a crown class of either B or C (52.5%) than non-host trees (41.9%), suggesting sapsucker feeding was associated with trees with thinner crowns and missing branches. This raises the question: Do Yellow-bellied sapsuckers choose large trees that are low in health? Or are they targeting large trees and causing the decline by drilling? Number of drillings can be used to determine if a tree has been used for a sustained period; trees with more than 25 drillings have had sustained use. Almost two-thirds of host trees were drilled more than 25 times, and of those, 87.1% had crown classes of either B, C, or D, suggesting that trees with sustained use are more likely to be in decline than trees without sustained use. Sustained use may be a strategy of sapsuckers to weaken trees to the point of disease or to the point of maximum sap production[10].

About a quarter of host trees exhibited callusing from long-term feeding by sapsuckers. There was no relationship to any particular tree species, as 12 tree species had calluses. There are no previous studies regarding Yellow-bellied sapsucker calluses or what causes them. The calluses may be physical damage done to the tree by sapsucker usage, or the trees' response to sapsucker usage. Calluses may form to reduce sap flow and drilling damage by sapsuckers. Research is needed to understand the circumstances under which calluses form.

There were limitations to my study that can be improved upon in further research. Searching for sapsucker use away from the trail would expand habitats surveyed. Increasing the range of elevation and including a greater number of habitats would include more potential host species. Instead of crown class an alternative method of analyzing tree health should be used. Estimating crown class in a tightly wooded forest was difficult due to overlapping canopies and uncharacteristic growth patterns. More research into how Yellow-bellied Sapsucker drillings affect tree health should be done to understand their relationship. Future studies should examine long term effects of sapsucker use on host tree health. Data collected from host trees could include potential differences in sap flow rate, sugar content of sap, and ages of different species of host trees.

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6. Literature Cited

1. Howell, T. 1952. Natural history and differentiation in the Yellow-bellied Sapsucker. Condor 54:237-282.
2. Walters, E.L., E.H. Miller, and P.E. Lowther. 2002. Yellow-bellied Sapsucker (*Sphyrapicus varius*). No 662, *In* P.G. Rodewald (Ed.). The Birds of North America. Cornell Laboratory of Ornithology, Ithaca, NY.
3. Ratcliffe, J. 2020. List of Rare Animal Species of North Carolina. N.C. Department of Natural and Cultural Resources, North Carolina Natural Heritage Program, Raleigh, NC.
4. Tate, J. 1973. Methods and annual sequence of foraging by the sapsucker. Auk 104:328–334.
5. Eberhardt, L. 2000. Use and selection of sap trees by Yellow-bellied Sapsuckers. Auk 117:41–51.
6. Beal, F. 1911. Food of the woodpeckers of the United States. USDA Biological Survey Bulletin 37:1–64.
7. McAtee, W. 1911. Woodpeckers in relation to trees and wood products. USDA Biological Survey Bulletin 39:1–99.

8. Graves, G. 2019. *Sphyrapicus varius* (Yellow-Bellied Sapsucker) use of *Cotinus obovatus* (American Smoketree) in the Ozark Mountains. Southeastern Naturalist 18(3):499-509.
9. Long, A. 2011. Orientation of sap wells excavated by Yellow-bellied Sapsuckers. Wilson Journal of Ornithology 124:164–167.
10. Varner III, J.M., J.S. Kush, and R.S. Meldahl. Characteristics of Sap Trees Used by Overwintering *Sphyrapicus varius* (Yellow-bellied Sapsuckers) in an Old-growth Pine Forest. Southeastern Naturalist 5(1):127-134.